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WHITE CLAY DEPOSITS IN CENTRAL PENNSYLVANIA

By

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Geological Occurrence.

Deposits of white clay in central Pennsylvania are mostly found in the Nittany Valley and invariably occur in the Upper Cambrian sandstone, known as the Gatesburg formation, a name applied by the writer to this sandstone because it forms the bulk of Gatesburg Ridge in Centre County. The clays are of residual origin, and the fact that they are distributed in a linear arrangement, parallel to the strike of the Gatesburg rocks, indicates they have been derived from the weathering of argillaceous strata in this sandstone formation, which in many places contains beds of impure dolomite and of sandstone mixed with clay. On account of this relation between the white clay and Cambrian sandstone it is evident there will be no sharp line of demarkation between the clay and the sandstone along the strike, but the two rocks will grade into each other. In some pits a body of clay may be dug a few feet from a deposit of very fine, almost pure, white sand but this sudden change is more likely to occur across the beds than parallel to them.

The bulk of the clay comes from the borders of abandoned iron mines and a great deal of it was taken out in the past, while the iron was being worked. It has been found as lenses, seams, and irregular masses associated with the limonite ore but as a rule outside the ore body. The clay within the area worked for ore is usually stained with iron. There are all gradations from clay

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This report was written in 1918, at the request of R. R. Hice, then State Geologist.

carrying considerable iron and of no use in the ceramic industries through red and pink to pure white clay, just as there are all gradations between the pure clay and clay high in sand. The association of the clay and iron is believed to be due to the fact that the iron has been carried in solution by underground water and concentrated where beds of argillaceous dolomite in the sandstone have weathered out, permitting the sandstone to break down and thus create an area through which the water very readily circulates. The circulating waters remove the soluble constituents, depositing the iron oxide through replacement of the dolomite, and leaving the insoluble argillaceous materials as clay. The tendency would be to carry all soluble materials toward the centre of this area, where the downward circulation of the water is good, and to leave the insoluble materials around the borders of what in time develops into a sort of basin. In the basin there will be more resistant masses which will not crumble down and these may be comparatively free from iron and contain some white clay. The waters entering the basin are, of course, carried away by good circulation underground, in some places being directed and aided by fractures in the strata. It is probable that faults have often directed the course of the circulating waters producing these iron and clay deposits.

Observations show that the clay occurs as a rule along the flank of the ridge or knoll of sandstone and the presence of a deposit is often indicated by a small depression on the surface. In prospecting for clay this fact should be kept in mind, but the depressions caused by underground circulation should not be confused with stream channels, which may bear no relation to the strata giving rise to the clay. There is no doubt that some transfer of the clay occurs beneath the surface and there is a concentrating process going on in these depressions by the underground water, but the extent of the movement of the clay particles is very limited.

Distribution of the clays.

The white clays in the Gatesburg formation are being, or have been, worked at a number of places in Centre, Huntingdon, and Blair counties. During the summer of 1918 clay was being shipped from the following deposits: the Colonial Clay Company's pit near Furnace Road just east of the Huntingdon-Centre County line; the Dungarvin pit at Dungarvin station in Huntingdon County; the Woodbury Clay Company's pit near Mines post-office in Blair County.

Besides these properties which have been shipping, there is a deposit about two miles west of Scotia Mines or Bonore in Centre County on which considerable work has been done. Drilling was carried on all summer (1918) on another property generally known as the Patton farm, about two miles east of Warriors Mark and about one-half mile from Dungarvin station. A considerable quantity of clay has been taken from the Pennington ore pits in the past.

The accompanying outline map shows the distribution of the Gatesburg formation and the location of the clay pits. The writer is indebted to Mr. Charles Butts of the United States Geological Survey

for the information regarding the distribution of the formation in parts of Huntingdon and Blair counties.

A detailed description of these deposits, which in many respects are much alike, will now be given.

Blair Property.

This property, controlled by Mr. Frank Blair of Bellefonte, Pa., is in Centre County between Benore or Scotia and Stormstown. It is on a low ridge of the Gatesburg sandstone. Many years ago a great deal of limonite was mined in this vicinity and it is said that several thousand tons of clay were removed from this area while the iron mines were in operation. About 1915 a further attempt was made to work the clay and a derrick was erected for hoisting. A hole was dug about 30 feet deep and three years later, in the spring of 1918, a shaft was sunk to a depth of 28 feet, in which, it is claimed, 21 feet of nearly white clay was found under reddish clay.

About 300 feet eastward from this shaft a pit 10 to 12 feet deep shows cream-colored clay and 50 feet northeast of this pit there is another said to be 30 feet deep with about 14 feet of clay. There is still another pit about 50 feet northeast of the one last mentioned, which shows reddish clay. Near this pit is an old drift from which clay was mined many years ago. From this description it is seen that these deposits are arranged roughly in a line and this is approximately parallel to the strike of the enclosing formations.

All these workings were full of water at the time of the writer's visit so it was impossible to examine the clay deposits in detail. Their situation along a depression has made drainage difficult and future operations must include some method of getting rid of the water which collects there, either by carrying it into the sandstone formation where it is free from clay and is porous, or by a ditch down the valley.

The clay is gritty and grades into sand but it can be washed so that it is almost entirely free from grit, and it has good plastic properties. The color is a cream-white, grading into a brick red where high in iron. Physical tests on this clay made by Dr. H. Ries in connection with his work on clays for the United States Geological Survey gave the following results: at cone 1(1150°C), absorption 16.2 per cent; hardness, not steel hard; color, faint cream-white, and at cone 11 (1350°C), absorption 15.7 per cent; hardness, steel hard; color, faint cream-white.

Another specimen from the same deposit gave the following results: at 1150°C: porosity, 46.5 per cent; hardness, almost steel hard; color, white; at 1350°C: porosity, 36.4 per cent; hardness, steel hard; color, cream-white. Under the microscope it shows some quartz, but most of the mass is very fine-grained and it apparently consists chiefly of kaolinite. These results indicate that the clay would be suitable, after washing, for whiteware and paper-making.

A few grains of rutile, tourmaline, and zircon may be distinguished and the presence of these minerals strengthens the evidence the writer has previously found relating to the source of the materials making up the Gatesburg formation. The evidence indicates that the quartz and clay have been derived from the metamorphic rocks of the pre-Cambrian lands exposed to weathering when these rocks were being laid down. In the burned clay the quartz grains show evidence of corrosion, but these grains as well as the zircon, are distinct and unfused. The matrix shows slight interference colors.

Colonial Clay Company's Property.

This is often spoken of as the Gates property because it is being operated by Mr. T. J. Gates of Tyrone. It is in Centre County just northeast of the boundary between Huntingdon and Centre and about one mile north-northeast from Furnace Road, a station on the Tyrone-Scotia branch of the Pennsylvania Railroad. The clay pits are associated with and some are in the abandoned iron ore workings.

The clay on this property, like that in other parts of the Nittany Valley, forms very irregular deposits in the Gatesburg sandstone, which makes a broad low ridge in this locality. These deposits are in a depression lying along the flank of a minor ridge on the main sandstone mass. Small hollows in the main depression often indicate the presence of clay beneath the surface. Their linear arrangement suggests that they are a residual deposit from the weathering of certain strata in the sandstone formation.

In 1918 operations were being carried on in a large pit and a face of nearly white clay 20 feet high was exposed. The clay extends from the soil on top to the bottom of the pit. The white clay grades into red clay high in iron on one hand and into white sand on the other, and all intermediate gradations may be seen. Care has not always been taken to prevent caving of the overburden and as a result much soil and sand have become mixed with the white clay in some parts of the pit. This is an important deposit and probably further prospecting will show other bodies of white clay in the vicinity.

The clay is hauled in wagons to a railroad siding about three-quarters of a mile distant, and the quantity shipped is stated as four to seven cars a week, depending upon the labor supply.

Physical tests made on a sample of the nearly white to cream clay by Dr. Ries showed that it possesses the following properties: at cone 1 (1150°C), absorption, 28.90 per cent; hardness, steel hard; color, very faint cream-white. The plasticity is good but the clay is gritty and would be improved by washing. The more sandy portions of this deposit are said to be used in iron foundries for moulding and some of the clay is shipped to potteries for manufacture of saggers. The white clay would make good paper clay when washed, as the color, plasticity and separation of the grit are good.

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Patton Property.

This property is about two miles east of Warriors Mark in Huntingdon County. Formerly some iron was mined here and considerable sand has been shipped from this property by a tramway connecting with the Scotia or Fairbrook branch of the Pennsylvania Railroad. There is an old pit from which several tons of good paper clay are said to have been dug some years ago.

During the summer of 1918 the West Virginia Pulp and Paper Company has been investigating the property with a view to obtaining white paper clays for their mills at Tyrone and elsewhere. The writer is indebted to Mr. S. A. Okell, chemist with this company, for his kindness in furnishing information regarding their work. Many holes have been sunk by driving pipes, a gasoline engine being used for power.

The clay occurs in the weathered portion of the Gatesburg formation along the northeast side of a ridge of the Warrior limestone and dolomite and probably in the vicinity of a fault. As in other areas the clay is found in the lower spots and there is little use in drilling on the higher land. The drill holes ranged from 50 to 75 feet deep and the materials commonly encountered were sand and white or yellow clay. The surface material above the clay or sand is 5 to 17 feet deep and the white clay is 15 to 40 feet below the surface. The thickest body of white clay penetrated was about 33 feet, at a depth of 20 feet. The drilling indicated that the deposits are very irregular in form and of quite limited horizontal extent. The clay is in pockets and although a drill hole may pass through a thick body at one point, another hole but a few feet away may miss it altogether, as it grades into impure clay or sand.

Most of the clay is sandy. It may carry 30 to 40 per cent of free silica but it can be readily washed and a good separation obtained. Physical tests reported by Dr. Reis for a good sample gave the following results: at cone 1 (1150°C), absorption, 26.2 per cent; hardness, steel hard; color, white; at cone 11 (1350°C) absorption 20.8 per cent; hardness, steel hard; color, faint cream-white. It is fairly plastic.

Deposits at Dungarvin Station.

Clay is being mined in considerable quantities close to the station of Dungarvin on the Scotia branch of the Pennsylvania Railroad, and just over a ridge of Gatesburg sandstone to the south from the Patton property, on the border of a large pit known as the Dungarvin iron mine. This property is controlled by Joseph D. Thropp, who has leased portions of it to others who are carrying on the work. Messrs. P. D. Deeters and H. F. Harpster of Warriors Mark are mining an extremely tough, plastic, pinkish clay, which would appear to be suitable for saggers and similar ware.

On the edge of the same pit where Deeters and Harpster are working, Mr. William L. Likens, also of Warriors Mark, is mining a cream to white clay. Some of this clay is very gritty and it grades into

a pure fine sand.

Both these deposits are very irregular in outline and the appearance of a working face may change rapidly from day to day. They are close to the surface. The white clay seems to be very similar in physical properties to the clays described above.

There are traces of clay in the Gatesburg sandstone in several places near Dungarvin and a thin seam similar to the clay on the Patton property may be seen in a sand bank which is being operated close to the railroad about two-thirds of a mile northwest from Dungarvin.

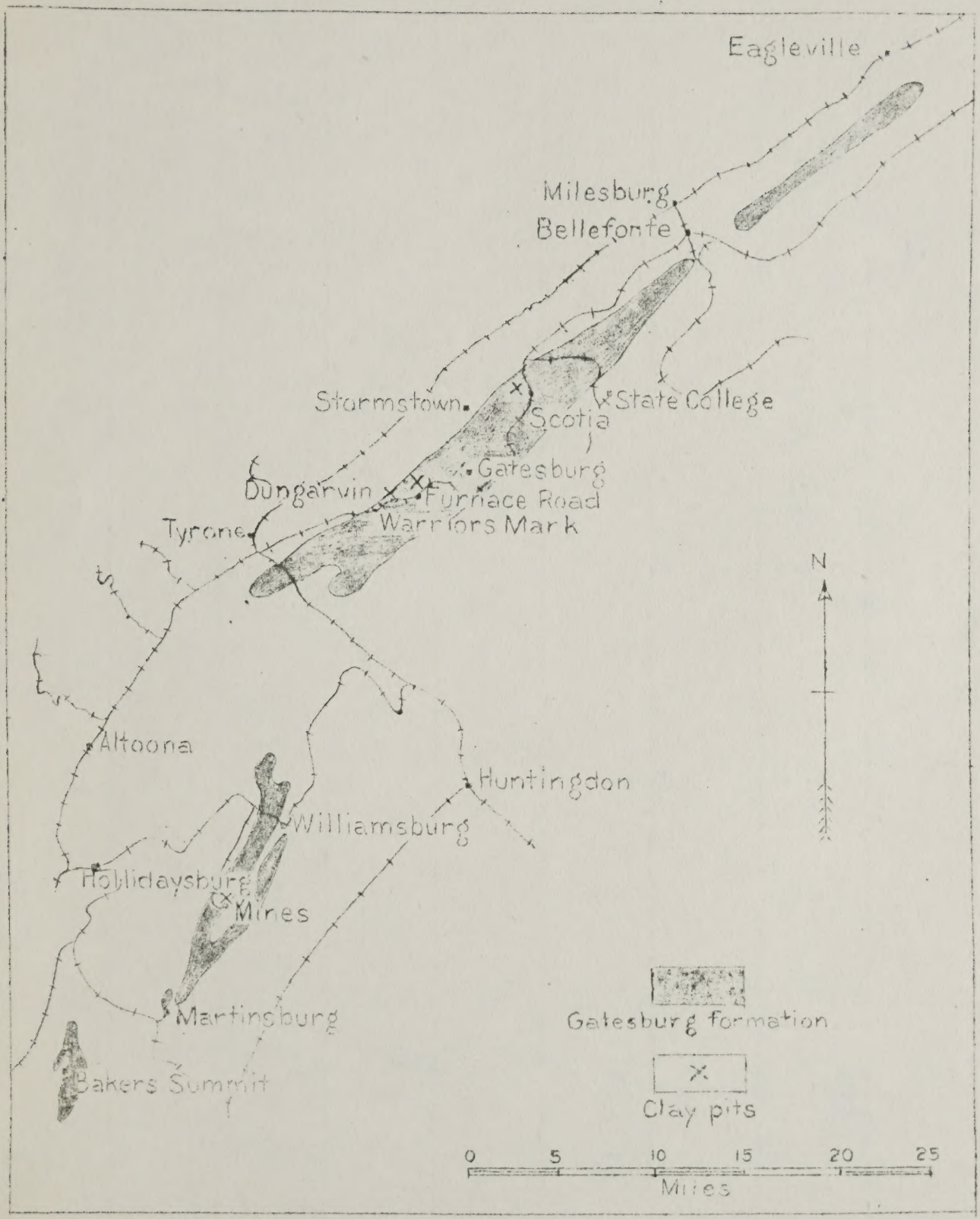
Woodbury Clay Company's Pit.

The Woodbury Clay Company is digging clay with steam shovels in an old iron ore pit about one mile from Mines, or Oreminea, and six miles from Williamsburg, Blair County. This pit is about 900 feet long and in places nearly 40 feet deep. It lies in the Gatesburg sandstone and the clay deposits are very similar to those already described. The clay is irregular in color and distribution, being in some places nearly pure white, or cream-colored, and in others a dirty gray, but weathering white. It grades into sand and may be seen filling cracks and pores in the weathered sandstone, indicating that it has been derived from the weathering of an argillaceous sandstone.

From this deposit about four carloads per day were being shipped in the summer of 1918. It is suitable for making paper, saggers, and white ware.

Possibility of discovering other deposits.

The typical association of white clay with the Gatesburg sandstone in central Pennsylvania suggests the good prospect of discovering deposits of clay in the wooded areas underlain by this formation. Although the white clay is usually associated with limonite ores, and most of it has doubtless been discovered in working the iron which has been mined so extensively in this section in previous years, the writer believes that chances of finding other clay-bearing areas are good. This sandstone should not be confused with the Oriskany sandstone, which is much later geologically than the Gatesburg but which also contains iron ore and clay in some localities. Near Shirleysburg the Oriskany formation carries a good deposit of clay in its upper strata and in some other places clay occurs within the formation at its base. The Oriskany sandstone is widely used in this State for the manufacture of glass sand but the Gatesburg is not suitable for that purpose.



Location of white clay deposits in Gatesburg formation, in central Pennsylvania.

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